KING COUNTY INTERNATIONAL AIRPORT ECONOMIC IMPACT STUDY 2008

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EXECUTIVE SUMMARY

"Boeing Field," which is formally named King County International Airport (KCIA) is the subject of this study. It is located in south Seattle in the Duwamish River corridor on land that is primarily located in Tukwila. The airport is the site of final production activity associated with the assembly and delivery of Boeing 737, and with the military AWACS program. It is also a major general aviation center, and the location of a significant share of the air cargo activity in the Puget Sound region. KCIA serves a diverse set of clients, ranging from private pilots to large corporate aircraft operations, as well as government organizations, retailers, wholesalers, and a variety of other services.

The economic impact of King County Airport is $3.2 billion in terms of business sales locally, that supports 12,618 jobs and creates $804 million in labor income in King County. About $68 million in state and local sales and B&O taxes were generated as a result of economic activity at the airport. Directly, 4,900 people worked at the airport in 2008, earning $475 million in labor income. Direct sales by businesses at the airport were $2.26 billion in 2008, $1.97 billion of which were accounted for by aerospace activity. Most business activity at KCIA was sold outside the county economy, as some 91 percent of the gross volume of sales represented "new money" to the county economy. This activity would not be present if the businesses at KCIA were not operating in King County. Thus, the airport contributes significantly to the economic base of King County. New money impacts led to sales of $3.0 billion in King County, generated 11,000 jobs, and created labor income of $729 million. These estimates of economic impact were developed using an input-output model specific to King County that traces the indirect and induced economic impacts of the direct spending associated with production at the airport.

Most tenants in the aviation service business do not expect a change in their corporate, general aviation, cargo, or flight school markets. Those expecting an increase in these activities are essentially offset by those expecting a decrease in these activities. Considering all tenants, recent changes in revenues have been split evenly between those reporting no change or those reporting a decline in their business, while a smaller share have experienced growth in their business. In terms of expectations for the next few years, a much darker picture was portrayed by tenants, with half expecting a decline in business. Regarding the balance, about one-fourth expected no change in their business, 18% thought their business would increase, and the balance (9%) did not answer this question or were unsure of their near future sales levels. However, comments about expected change have a sunnier tone, with many tenants expecting a recovery of business activity in a few years.

This study reports a larger economic impact for KCIA than two previous studies, with about 2,000 more jobs in the local economy supported by the airport in King County. This is largely driven by higher estimated employment and business activity in the aerospace sector than in the two previous studies. There have been changes in non-aerospace activity at the airport, with declines in retail & wholesale and government employment. FBO and corporate air, and airline and air cargo activities have been stable, while "other" employment has risen. Output and labor income multipliers appear to be lower than in previous studies, while the employment multiplier has been unchanged across the three studies of KCIA economic impacts.

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The authors of this study accept the responsibility for any errors made in the use of information supplied by those interviewed in the course of this study.

I. Introduction

Overview of Tenant Categories

Seven broad categories of tenants are identified at KCIA. They are (1) aerospace manufacturing businesses, (2) fixed base operators (FBOs), and corporate air businesses, (3) air passenger and air cargo businesses, (4) retailers and wholesalers, (5) government agencies, (6) service industry and other tenants, and (7) general aviation. A brief description of each of these categories of tenants is now provided.

(1) Aerospace Manufacturing and Delivery This category is dominated by the Boeing Company, which has major facilities located on the west side of KCIA associated with the delivery of the 737 product line. Boeing flies these aircraft to KCIA and completes painting and some aspects of final assembly there. Boeing's clients and engine suppliers also have a major presence at KCIA. The sale process separates engine sales from the sale of the rest of the aircraft, so engine manufacturers are also present in relation to final sales. The airlines that are making purchases of these aircraft also have staff located at KCIA who are involved with the inspections and other documentation related to the transfers of title and sale of these aircraft to customers of the Boeing Company. It is our understanding that some military/defense activities of the company are also conducted at KCIA, but in interviews with the Boeing Company the nature of these activities were not identified specifically. In addition, Boeing Business Jets has a presence at the airport; this division is involved in selling Boeing jet aircraft to non-airline customers. While the Boeing Company is by far the largest employer within this category, on the east side of the field there are also several companies engaged in the manufacture of parts or components sold to the aerospace trade, and who provide services related to aerospace component production taking place elsewhere.

(2) FBOs and Corporate Air and Training Along the east side of the field there are a number of establishments serving largely business markets for private and corporate aircraft. This industry segment at the airport is complex; each enterprise has a somewhat different market focus. Some establishments primarily service jet aircraft either owned locally by wealthy individuals or businesses that they control, while others cater to a diversified set of clients who fly in and out of KCIA. These establishments provide a variety of services to their clients. They service the aircraft that are permanently based or temporarily located at their site. They provide support services such as limousine services, taxis, or car rental and hotel accommodations for people who fly into KCIA and are attending meetings or attending other business functions in the local area. They arrange food services for on-the-ground or in-flight needs. They refuel aircraft. They provide service on aircraft visiting and housed at KCIA. They also provide training to people learning to become pilots. Businesses only providing training are included with the services sector in this study. There are a number of businesses that also sell aircraft. In some cases, these are establishments servicing a particular corporate client or they are engaged in the myriad of activities just described.

(3) Passenger Transportation and Air Cargo KCIA is also the site for a portion of the scheduled (and charter) air taxi transportation market in the Central Puget Sound region. It has several carriers who fly to western Washington and Portland OR. More

important than passenger airline activity at KCIA are the air cargo carriers. Several of these are major enterprises in the global air cargo industry. KCIA is also the focal point for consolidators to bring shipments from regional locations to air cargo carriers who move shipments into national and international markets. KCIA is also the base for the transportation of people within the region for emergency medical care; Seattle serves as a hub for such care, and KCIA serves as the inbound location for people being transported into the Seattle area from outlying regions for movement into area hospitals. In some cases, this movement from KCIA to local hospitals is undertaken by helicopter.

(4) Retail and Wholesale KCIA has a number of businesses that are engaged in retail and wholesale activity. They are heterogeneous in nature. Some establishments are clearly focused on selling to the small-aircraft or corporate-aircraft trade located on the east side of KCIA. Others are simply renting inexpensive space on the periphery of the airport.

(5) Government There is a sizeable public sector presence at KCIA, related to a variety of functions performed by Federal agencies and King County. The federal presence at the airport is related to the FAA that operates the control tower, NOAA that maintains an unmanned instrumentation station for weather, and the Department of Homeland Security that handles functions similar to those previously lodged in the Immigration Service and the Customs Service. The State of Washington rents space at the north end of the airport for a local Air National Guard Communications unit at $1 per year**.** King County uses a number of spaces at the airport for functions clearly related to the airport itself (such as airport administration, air rescue firefighting unit, or emergency transport), and functions taking advantage of low-cost office space (such as a special sheriff's office facility).

(6) Services and Other Activity KCIA is also the location of a number of other business activities. Some of these are located on the west side of the field, while others are on the east side. They are extremely diverse in their nature. These businesses include the Museum of Flight at the southwest corner of the field. Although technically, the Museum of Flight is not an airport tenant, KCIA staff and the museum consider themselves part of the airport "family," and today it does use some space on airport property. One establishment serves food to passengers using the terminal building for scheduled flights and to airport employees. Several producer service businesses with no relationship to the airport simply rent office space through KCIA tenants. There are also firms providing services to people interested in training to be pilots which are unrelated to the FBOs and businesses included in group (2) above. Several firms that provide repair service work for the aircraft industry are located at KCIA. **Several construction companies have offices at KCIA**. This is a heterogeneous collection of tenants, most of whom are tightly tied to the airport for their business activity, but there are some "outliers" who are airport tenants largely due to low cost of space for their business activity.

(7) General Aviation KCIA is the home base for more than 500 aircraft, some of which rent space from King County, while others rent space from FBOs or other

establishments serving the corporate air community. We did not survey the owners of these aircraft. However, the expenditures that they make in relation to operating their planes from KCIA, such as fuel and maintenance, would be included in the revenues of the FBOs and others providing services to aircraft at the field. A part of the revenue stream to King County comes from these tenants and the County has some costs associated with servicing these general aviation tenants. The expenses incurred by the County in relation to these general aviation tenants is included with the overall operating costs estimated for the King County Airport Administration establishment. We recognize that general aviation is an important activity at KCIA and we believe that our survey has captured on-site expenditures made by those owning these aircraft.

II. Direct Impacts

Economic impacts are calculated by relating direct economic impacts to the input-output model. Given the formulation that we are using in this study, we needed to estimate sales, employment, labor income, other value added, and regional purchases by all of the tenants covered in this study. These estimates were made as follows.

Through our survey of tenants (see Appendix A for our questionnaire, and Appendix B for a tenant list), we sought information on sales and employment. In many cases, we obtained both, but in a number of cases tenants could only provide us with the number of employees that they had and their estimated labor costs for these employees. We developed employment estimates for all tenants included in the study. We sought these from the tenants themselves, but in some cases we relied on *Reference USA*, an online data source for information about individual businesses. The 2002 Washington State Input-Output model was used to develop ratios of employment, output, and labor income by industry. Prices in this model were benchmarked against the year 2008, so estimates of these relationships were pertinent to the year of our impact estimate. Data provided by tenants supplied coverage of 92% of the estimated 2008 employment at KCIA. Appendix C contains technical information on the input-output model.

By far the most important statistic resulting from this process is the aerospace figure. Boeing provided an estimate of the number of their employees working at KCIA, as well as an estimate of the number of airline and engine manufacturer representatives located at KCIA. Boeing was unable to separate the value of their KCIA activity from their overall Puget Sound area business activity and could not estimate the effective sales per person employed by the airlines and engine manufacturers. Therefore, an average value of revenue per employee in aerospace was used to estimate sales by manufacturers in this sector (there were several other aerospace manufacturers besides Boeing included with this sector). Airline representatives were classified with business services in the impact analysis, as these entities were not engaged in manufacturing, and were providing services related to the delivery of aircraft.

Table 1 reports the results of the estimation of sales and labor income, as well as the estimated employment at KCIA and the labor income per employee by industry

group. Almost 4,900 people worked at KCIA in the year 2008, earning an estimated $475 million in labor income. Sales of $2.3 billion occurred, the bulk of which originated in the aerospace sector. There is a considerable variation in labor income per worker across the different industries included in this table. In general, labor income of people working at KCIA is well above the Washington State average of $44,800 in wage and salary income in the year 2008[1].

Table 1 Sales, Employment, and Labor Income

	Sales ($ millions)	Employment	Labor Income ($ millions)	Labor Income/Employee
Aerospace	$1,971.97	3,553	$398.445	$112,143
FBO/Corporate Air	115.11	376	25.32	67,430
Airlines & Air Cargo	115.26	376 (537)[2]	25.353	47,212
Retail & Wholesale	5.8	68	2.142	31,500
Government	18.597	201	12.069	60,045
Other	30.121	292	11.419	39,106
Total	$2,256.858	4,866	$474.748	$97,574

The direct requirements of businesses located at KCIA were estimated as follows. We used the direct requirements coefficients in the input-output model for the appropriate sectors to estimate direct purchases, or utilized the estimates of labor income that came from the survey of tenants rather than the input-output coefficients. This procedure was used to estimate purchases of each of the groups of tenants identified in Table 1, and then a composite purchases vector was derived, as shown in Table 2.

[1] http://www.workforceexplorer.com/admin/uploadedPublications/9422_2008-2PubPrelim.xls

[2] The estimate of 376 persons is a full time equivalent estimate. The estimate of 537 is the full and part time estimate provided to us from businesses in this sector. The value of 376 was used in the impact estimates and in the total.

Table 2 Direct Requirements ($ millions)

	Output (mils. $2008)
1. Crop Production	$0.002
2. Animal Production	0.000
3. Forestry and Logging	0.000
4. Fishing, Hunting, and Trapping	0.070
5. Mining	0.007
6. Electric Utilities	1.286
7. Gas Utilities	0.158
8. Other Utilities	1.108
9. Construction	7.028
10. Food, Beverage and Tobacco Manufacturing	0.352
11. Textiles and Apparel Mills	0.229
12. Wood Product Manufacturing	0.078
13. Paper Manufacturing	0.114
14. Printing and Related Activities	0.853
15. Petroleum and Coal Products Manufacturing	2.124
16. Chemical Manufacturing	1.785
17. Nonmetallic Mineral Products Manufacturing	0.246
18. Primary Metal Manufacturing	1.541
19. Fabricated Metals Manufacturing	4.810
20. Machinery Manufacturing	0.637
21. Computer and Electronic Product Manufacturing	4.841
22. Electrical Equipment Manufacturing	0.218
23. Aircraft and Parts Manufacturing	32.398
24. Ship and Boat Building	0.000
25. Other Transportation Equipment Manufacturing	0.038
26. Furniture Product Manufacturing	0.123
27. Other Manufacturing	2.062
28. Wholesale	12.937
29. Retail	3.519
30. Air Transportation	0.203
31. Water Transportation	0.323
32. Truck Transportation	0.558
33. Other Transportation/Postal Offices	2.057
34. Support Activities for Storage, Transportation and Warehousing	9.755
35. Software Publishers & Internet Service Providers	3.443
36. Telecommunications	6.622
37. Other Information	0.919
38. Credit Intermediation and Related Activities	4.099
39. Other Finance and Insurance	12.041
40. Real Estate and Rental and Leasing	9.872

Table 2, continued	
41. Legal /Accounting and Bookkeeping /Management Services	15.186
42. Architectural, Engineering, and Computing Services	9.342
43. Educational Services	9.311
44. Ambulatory Health Care Services	0.140
45. Hospitals	0.000
46. Nursing and Residential Care Facilities, Social Assistance	1.275
47. Arts, Recreation, and Accommodation	1.080
48. Food Services and Drinking Places	1.189
49. Administrative/Employment Support Services	10.974
50. Waste Management/Other, and Agriculture Services	3.497
Total	$180.448

Table 2 indicates that KCIA business establishments purchased $180 million within King County in the year 2008, with the strongest purchases being made from service industries. Strong purchases are made from other regions, dominated by the imports of components to the aerospace sector from elsewhere in the United States and abroad. Labor income payments are the largest outlays made in the regional economy and form a principal basis for indirect and induced effects that are captured by the input-output model.

III. Direct, Indirect and Induced Impacts

The input-output model calculates estimates of indirect and induced effects, which are added to the direct impacts to obtain estimates of total impacts, as presented in Table 3. The $180 million in direct purchases made from industries in King County and the $475 million in labor income stimulate the regional economy, producing levels of output, employment, and labor income well above direct impacts reported in Tables 1 and 2. Table 3 indicates that total sales in King County related to activity at KCIA were more than $3.2 billion in 2008, that more than 12,600 people were employed due to the airport, and over $0.8 billion in labor income was earned as a result of activity at KCIA. The strongest impacts are felt in various service industries. A comparison of the direct impacts reported in Table 2 with the total impacts reported in Table 3 shows strong impacts within transportation services; retail trade; finance, insurance, and real estate; business services; health services; and other services. Impacts within the aerospace sector are very small, reflecting the relatively weak intraindustry linkage within this sector in the regional economy.

Table 3 Direct, Indirect and Induced Impacts

	Output (Mils. $2008)	Employment	Labor Income (Mils. $2008)
1. Crop Production	$0.188	1	$0.035
2. Animal Production	0.155	2	0.037
3. Forestry and Logging	0.037	0	0.005
4. Fishing, Hunting, and Trapping	1.051	8	0.466
5. Mining	0.526	2	0.098
6. Electric Utilities	29.054	30	3.127
7. Gas Utilities	8.773	5	0.515
8. Other Utilities	5.655	21	1.256
9. Construction	44.118	223	12.900
10. Food, Beverage and Tobacco Manufacturing	20.464	58	3.016
11. Textiles and Apparel Mills	0.393	4	0.138
12. Wood Product Manufacturing	0.497	2	0.112
13. Paper Manufacturing	1.368	3	0.272
14. Printing and Related Activities	3.372	28	1.431
15. Petroleum and Coal Products Manufacturing	6.447	1	0.087
16. Chemical Manufacturing	3.809	3	0.756
17. Nonmetallic Mineral Products Manufacturing	2.056	8	0.465
18. Primary Metal Manufacturing	1.831	5	0.330
19. Fabricated Metals Manufacturing	6.323	35	1.854
20. Machinery Manufacturing	1.482	8	0.490
21. Computer and Electronic Product Manufacturing	5.531	28	2.379
22. Electrical Equipment Manufacturing	0.448	2	0.107
23. Aircraft and Parts Manufacturing	1,952.784	3,156	369.725
24. Ship and Boat Building	0.514	3	0.316
25. Other Transportation Equipment Manufacturing	0.524	1	0.102
26. Furniture Product Manufacturing	1.130	9	0.394
27. Other Manufacturing	3.725	22	1.092
28. Wholesale	56.563	276	18.401
29. Retail	114.949	1,339	42.765
30. Air Transportation	237.435	775	52.412
31. Water Transportation	5.208	11	0.890
32. Truck Transportation	9.677	78	3.892
33. Other Transportation/Postal Offices	16.282	151	8.161
34. Support Activities for Storage, Transportation and Warehousing	13.131	103	6.864
35. Software Publishers & Internet Service Providers	5.719	14	3.324
36. Telecommunications	49.570	128	10.822
37. Other Information	32.237	121	9.279

Table 3, continued			
38. Credit Intermediation and Related Activities	59.904	255	14.593
39. Other Finance and Insurance	61.153	241	18.391
40. Real Estate and Rental and Leasing	65.093	463	13.645
41. Legal /Accounting and Bookkeeping /Management Services	49.417	533	32.768
42. Architectural, Engineering, and Computing Services	68.157	588	45.094
43. Educational Services	26.240	355	8.920
44. Ambulatory Health Care Services	44.656	435	26.391
45. Hospitals	34.027	264	15.714
46. Nursing and Residential Care Facilities, Social Assistance	22.202	454	11.760
47. Arts, Recreation, and Accommodation	26.675	475	10.792
48. Food Services and Drinking Places	45.903	835	15.875
49. Administrative/Employment Support Services	28.380	531	16.909
50. Waste Management/Other, and Agriculture Services	51.529	526	15.366
Total	$3,226.363	12,618	$804.533

The input-output model has a different multiplier for each sector. It is possible to develop summary or aggregate multipliers for the three measures of impact reported in this study. Table 4 reports these aggregate multipliers. They were calculated by dividing the total impacts for each category of impact by the direct impact measures. For example, the 4,866 people directly employed at KCIA support a total of 12,533 jobs in the regional economy, or 2.59 jobs for each direct job at KCIA. The same computational process was used to derive the output and labor income multipliers contained in Table 4.

Table 4 Aggregate Multipliers

Output Multiplier	1.43
Employment Multiplier	2.59
Labor Income Multiplier	1.69

A more compact version of Table 3 is reported in Table 5. This table distinguishes between manufacturing and non-manufacturing impacts, and also separates non-manufacturing into two service industry components and a non-services grouping. Impacts of KCIA are distributed broadly across each of these aggregate groupings of sectors in the input-output model.

Table 5 Summary of Direct, Indirect, and Induced Impacts

	Sales ($ Millions)	Employment	Labor Income ($ millions)
Natural Resources and Utilities	$45.439	70	$5.538
Construction and Manufacturing	2,056.816	3,598	395.965
Retail and Wholesale Trade	171.512	1,615	61.167
Producer and Transport Services	672.983	3,461	220.135
Consumer Services	279.612	3,874	121.728
Total	$3,226.363	12,618	$804.533

Tax Revenues

Business activity in King County related to KCIA leads to collections of state B&O taxes, while the spending of labor income yields sales tax revenues to the State of Washington and local governments. Table 6 presents estimates of these tax collections for the year 2008. The B&O tax revenues were calculated by multiplying the sales of each sector by estimated collections per dollar of output and summed across the sectors to yield the total reported in Table 6. State and local sales tax impacts were estimated as a function of labor income and personal income.

Table 6 Selected Tax Impacts ($ millions)

State Sales Tax	$30.435
Local Sales Tax	14.047
State B&O Tax	16.297
Local B&O Tax	6.870
Total Taxes	$67.650

New Money Impacts

A second measure of economic impact is referred to as "new money." The previous section presented estimates of economic impacts for all spending taking place at KCIA in 2008. Some of this was spending made by local residents or businesses for goods and services that could be produced someplace else in the region if the airport were not sited here. However, a significant proportion of the activity at the airport involves non-local demand and is production taking place locally that would not occur in the region if the airport were not located here. Table 7 presents estimates of the new money or export share of activity by major industry category at KCIA. The share of markets of KCIA tenants that were made in King County was ascertained in the survey of tenants; this survey is the basis for estimating the level of new money activity taking place at the airport. Clearly, in the aggregate new money accounts for the bulk of revenues and jobs at KCIA.

Table 7 New Money Estimates of Sales and Employment

	Sales ($ Millions)	% New Money Sales	Employment
Aerospace[3]	$1,971.97	100.0%	3,553
FBO & Corporate Air	68.35	59.4%	223
Airlines & Air Cargo	69.89	60.6%	228
Retail & Wholesale	1.73	29.7%	20
Government	2.38	12.8%	26
Other[4]	7.04	23.4%	71
Total	$2,121.35	94.0%	4,121

Through the use of the same methodology as described above for total sales, estimates were made of the economic impact of new money demands and direct requirements. Table 8 presents summary impacts from these new money estimates, which are proportionally similar to approximately 90% of the impacts reported in Tables 3 and 5. However, these impacts are not exactly proportional due to the variation in the share of sales of the different sectors included in this study that are new money and the varying distributions of direct requirements across the sectors included in this study. New money output impacts are approximately 93% of the total output impacts, while for employment and labor income the comparable percentages are 88% and 91% respectively. This new money analysis indicates that King County's economy has over 11,000 jobs that would not exist if production at KCIA was not located there.

Table 8 New Money Summary Impacts

	Sales ($ Millions)	Employment	Labor Income ($ Millions)
Natural Resources and Utilities	$40.623	63	$4.962
Construction and Manufacturing	2,039.550	3,523	391.380
Retail and Wholesale Trade	151.194	1,416	53.882
Producer and Transport Services	512.988	2,684	172.454
Consumer Services	243.68	3,360	106.074
Total	$2,988.035	11,045	$728.752

The new money impacts are similar in their distribution to the overall impacts of KCIA. The domination of aerospace in the new money impact scenario is even greater than in the baseline impact estimate. However, the indirect and induced impacts of both scenarios are largely felt in the services related to the consumption-related effects associated with the spending of labor income.

[3] Includes Boeing, engine manufacturer representatives, and airline customer staff; the airline customer staff were treated as producer service employment in the impact analysis.
[4] Excludes airline customer staff, who were treated as producer service employment in the impact analysis.

A final perspective on new money is given in Table 9, which contains tax revenue impacts associated with the new money scenario. This table indicates that tax revenue impacts are approximately 91% of the values reported in Table 6.

Table 9 New Money Tax Impacts ($ millions)

State Sales Tax	$27.569
Local Sales Tax	12.724
State B&O Tax	14.553
Local B&O Tax	6.168
Total Taxes	$61.013

In summary, KCIA created over 12,600 jobs in King County in 2008, and over 11,000 of these are "new money" jobs that would not be here if business at KCIA were not present. It generated $3.2 billion in sales, $0.8 billion in labor income, and $67 million in tax revenues to state and local governments that represented net gains to the regional economy due to the presence of the airport.

It should be noted that these economic impact estimates are limited to producers located in King County. Spending by users of the airport also lead to production elsewhere in the regional and state economy, such that there are other economic impacts regionally that are not captured in this study. For example, fuel sold at the airport is not refined in King County, but much of it is refined at petroleum refineries located in north Puget Sound. It was not possible in this study to document the larger economic impacts of KCIA on the Central Puget Sound region or Washington State economies. If measures of spending related to production elsewhere in the state economy had been measured, the economic impacts would be higher than documented in this report.

IV. Markets and Changes in Business Activity

Table 10 reports the market composition of different types of tenants at KCIA. These data are based on the survey of tenants. The dominant aerospace sector is estimated to have entirely industry clients, although there may be some military activity that would have federal government revenue. Data used for this project could not isolate these possible military markets for the aerospace sector. Given the dominance of the aerospace sector, overall (total) market orientation is largely to industry, with small aggregate household and government markets. Revenue in the government sector is dominated by the employment at King County offices located at the airport, whose revenue comes from King County. The "other" category includes the economic activity of airlines with offices related to airplane deliveries at KCIA. If these businesses were excluded, the markets of the remaining businesses would be stronger with households and local governments, as this would include organizations such as the Museum of Flight, and activities such as flight training and instrument repair services. The markets of air cargo carriers are difficult to estimate, as carriers such as UPS do not have detailed accounting information on the split between household and industry markets for the parcels they are moving through KCIA.

Table 10 Current Market Composition

Tenant Category:	% Industry	% Households	% State & Local Government	% Federal Government	Total
Aerospace	100.0%	0.0%	0.0%	0.0%	100.0%
FBO/Corporate Air	85.5%	6.6%	1.5%	6.3%	100.0%
Airlines/Air Cargo	63.4%	22.5%	13.1%	1.1%	100.0%
Retail & Wholesale	57.7%	29.8%	12.0%	0.5%	100.0%
Government	23.8%	0.8%	73.7%	1.8%	100.0%
Other	69.2%	20.4%	10.3%	0.0%	100.0%
Total	88.0%	5.5%	6.1%	0.4%	100.0%

The survey also documented the share of markets of each type of tenant that were located in King County. Table 11 reports these market shares. In the aggregate, it is estimated that 14% of total sales are made to clients located in King County. Aerospace is estimated to have no current account sales in King County, while most of the revenue to government entities and retail and wholesale establishments come from local sources[5]. FBO/corporate air and airlines/air cargo carriers have split markets, with about 40% of their revenue from local sources, and 60% from outside King County.

Table 11 Share of Markets in King County

Aerospace	0.0%
FBO/Corporate Air	40.6%
Airlines/Air Cargo	39.4%
Retail & Wholesale	70.3%
Government	87.2%
Other	27.3%
Total	13.5%

Market Trends

Several questions were included in our interviews that were aimed at better understanding changes in business activity at KCIA during the last several years and providing a perspective on where tenants thought that their businesses were headed in the next several years.

Expected Changes in Market Composition and King County Business Activity

Respondents to the survey were asked to estimate the share of their markets by category five years from now, and to also estimate the share of their business that would be located in King County. Tables 12 and 13 present results of these questions. Many respondents did not think that their market composition would change; the data in Table

[5] Sales of aircraft to Alaska Airlines, which is headquartered in King County, were not considered local sales, as these aircraft are largely used outside King County.

12 are quite similar to those reported in Table 10. Industry markets are expected to be slightly stronger five years from now, while household and state & local government markets are anticipated to be smaller. It should be noted that some establishments that reported current sales were unable to estimate their market composition five years from now, so the differences between Table 10 and Table 12 may not reflect a trend, but instead differences related to the sample.

Table 12 Expected Composition of Markets Five Years from Now

	Industry	Household	State & Local Government	Federal Government	Total
Aerospace	100.0%	0.0%	0.0%	0.0%	100%
FBO/Corporate Air	88.2%	8.4%	0.8%	2.5%	100%
Airlines/Air Cargo	59.3%	24.7%	14.8%	1.2%	100%
Retail & Wholesale	56.6%	30.6%	12.4%	0.5%	100%
Government	0.0%	0.0%	100.0%	0.0%	100%
Other	90.6%	0.0%	9.4%	0.0%	100%
Total	93.2%	2.4%	4.2%	0.2%	100%

The expected share of markets in King County in five years is reported in Table 13. The last column of this table reports the current estimated King County market share. The overall estimated King County market share remains low, only 14% of total sales. This overall King County market is expected to remain low. Expressed alternatively, the strong export market orientation of establishments at KCIA is expected to continue. Several establishments in the "other" category did not report expected King County market data five years from now, which results in lowered estimated King County markets for this group of tenants when compared to current King County markets. The higher estimated King County market for government is also a result of some non-responses by government establishments located at KCIA.

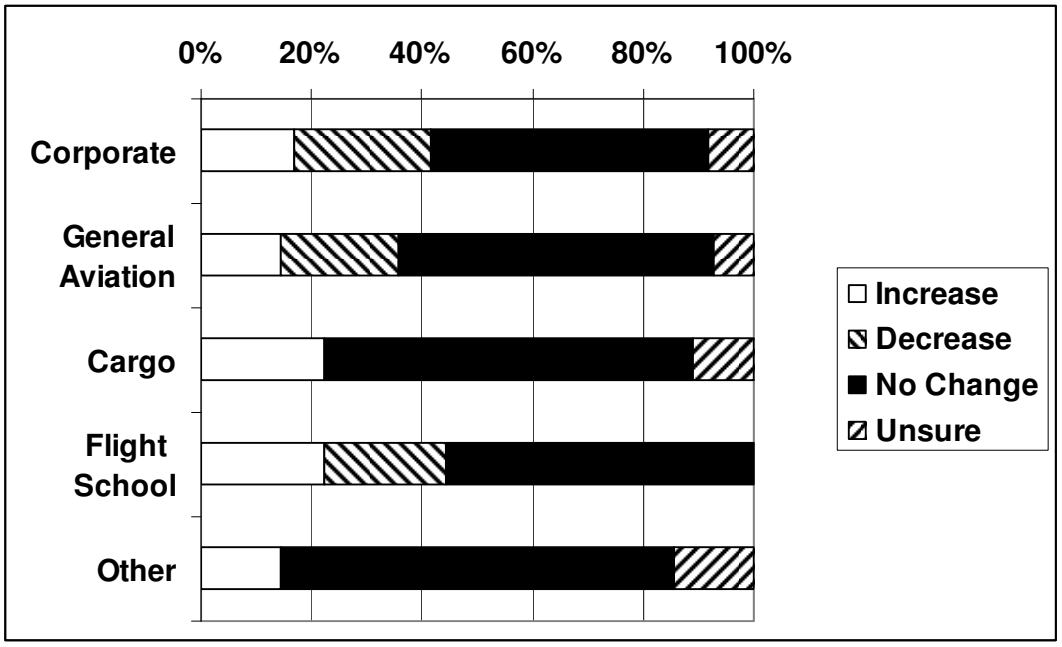
Table 13 Expected King County Markets in Five Years (% of total sales/revenue)

	Industry	Households	State & Local Govt.	Federal Govt.	Total King	Current King
Aerospace	0	0	0	0	0.0%	0.0%
FBO/Corporate Air	37.3%	7.6%	0.0%	0.0%	44.9%	40.6%
Airlines/Air Cargo	24.0%	12.3%	4.0%	0.6%	41.0%	39.4%
Retail & Wholesale	34.1%	23.1%	11.8%	0.0%	69.0%	70.3%
Government	0.0%	0.0%	100.0%	0.0%	100.0%	87.2%
Other	90.6%	0.0%	8.2%	0.0%	8.2%	27.3%
Total	14.6%	1.4%	3.1%	0.0%	8.1%	13.5%

Survey respondents were asked to indicate how they thought their air-related business would change over the next two to five years. Corporate air, general aviation, cargo, flight school and "other" aviation business were the categories used for this question. Many tenants did not reply to this question, as it did not relate to their business. For example some government offices do not have any business ties related to these categories of aviation activity. These questions do not apply to Boeing, as their business is not directly related to these categories. This question is most relevant to FBO/Corporate air, and air cargo tenants. Figure 1 reports the composition of responses received for this question. Most of those responding about one or another category reported in Figure 1 did not expect change in their business. Respondents expected a downturn in activity in corporate air, general aviation, and flight school activity about as often as they anticipated an increase in this activity. Cargo and "other" activity were perceived to be stable or increasing. A set of quotes regarding particular lines of activity are presented below.

Corporate: "Depends on a strong economy." "See emerging markets in places like Russia, China, and India." "Corporate air will expand because it is practical; it allows people to travel more extensively in a given time than commercial aviation." "Hanger space is a limiting factor; high cost has driven away some customers; are anticipating big demand for Galvin's planned big new hanger."
General Aviation "Decrease will largely come from small aircraft." "Thinks BFI is not trying to accommodate GA, given the lack of new hanger space that is needed to provide service to airplanes."
Cargo "Business to business is decreasing, while business to residential is increasing." "Business tends to go up in the spring when they carry specialty crops like fresh cherries."
Flight School "Hope to still be in business this March." "Very concerned about the economy."
Other: "Charter market is growing."

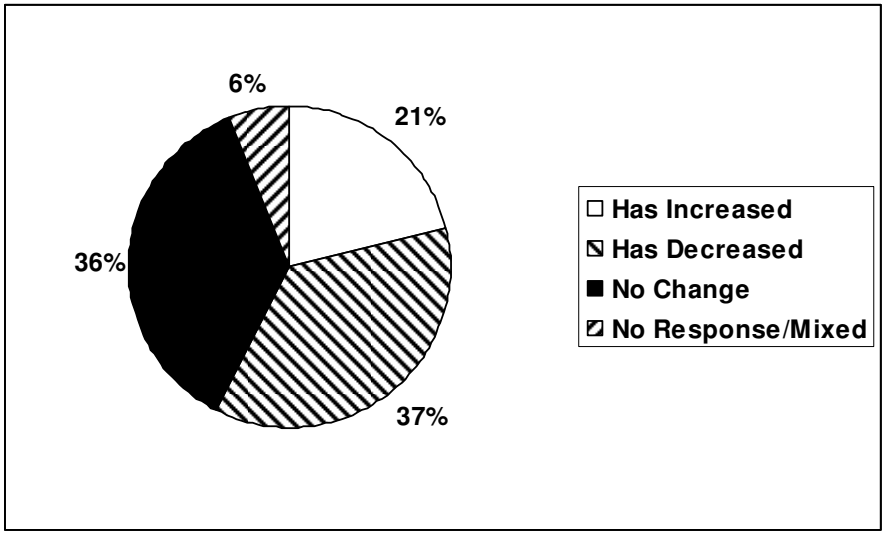
Figure 1 Expected Changes Air Transport Related Business Activity



Recent Trends in Business Activity

Respondents to our survey were asked if their business was up or down since the downturn in the national economy began in 2006. Why we selected 2006 as a benchmark for the downturn of the national economy is to be questioned, as this study was conducted in 2008 and early 2009. However, the responses to this question are presented in Figure 2, where we find that many respondents have had a decline in sales, but almost the same share have not experienced a change in revenues. Just over one-fifth of the respondents reported an increase in sales, while about 6% could not indicate how their sales had changed.

Figure 2 Change in Sales (Revenue) During the Past Two Years



N=33

Some respondents to the survey provided text about reasons why their business has changed. We report these responses below. They are not exact quotes, but rather summaries of what these respondents told us.

Business Up

"Growth of 3-5% per year, mostly comes by word of mouth." "Revenue up due to landing fee increases." "They have become responsible for management of vacant properties." "Revenue up due to increased price of fuel." "Their revenue is up because they decided to grow."

No Change

"No change, as there is a steady demand for their students."

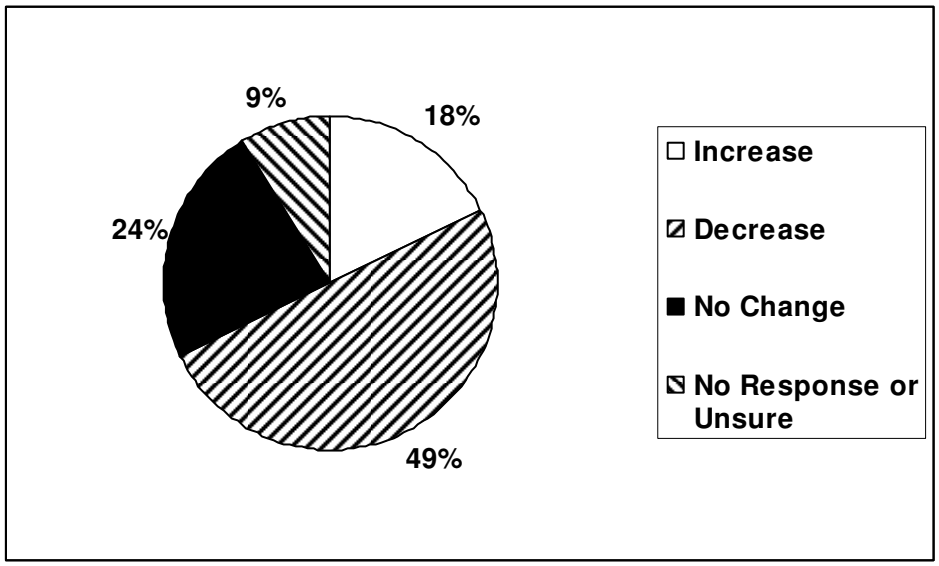
Business down

"They are shrinking. This is due to consolidation by the federal government to reduce the number of stations. Functions currently done here will be transferred to other hubs." "We are in a cost squeeze." "Economic slowdown started in 2008; 2007 was good. Sales have been off by 60%." "Decrease are due to fewer customers in flight training." "Decrease in sales affected by who is elected and state and federal level and how they choose to allocate funds for transportation." "Business down. They saw high fuel costs coming, budgeted for it." "Business down in part because people have gone out of state to get service; people have stopped getting equipment upgrades."

Expectations For Change in Business in The Near Future

Respondents were also asked how they anticipated their sales to change over the next two years (to 2010), as reported in Figure 3. This figure shows almost half of the respondents expecting a decrease in revenues, and only about one-six of them expecting an increase in sales. This is a bleaker picture of the near future, compared to the recent past as reported in Figure 2.

Figure 3 Expected Change in Sales or Revenue During the Next Two Years



N=34

Respondents offered more comments about their expected business change than they did about their recent business change. Summaries of these comments are presented below. Some are verbatim quotes, while others are summaries of notes made about conversations with tenants. While many respondents expect their business to decline, as reported in Figure 3, there are more comments anticipating a resumption of growth than an ongoing downward slide.

Business Up

Thinks things will get better with recovery of the economy. Sees increase, but this is tied in part to fuel costs; thinks swings are temporary. Expects growth due to cost of living allowances, utility charge increases, and FIRE increases. Expects a turnaround, with a 5% to 10% increase in business. With population growth their business will go up, as there will be more biosolids to be trucked. Thinks revenue will go up due to their business plan. "They hope to grow."

No Change or Uncertain

Revenue to KCIA will not change even though they will be smaller, due to nature of the contract. Feels the airport does not support flight training. Impacts are shielded because they have long-run contracts. Recovery of business tied in part to what happens to stock market. "They have to provide "more efficient services."

Business Down

"Revenue will decrease due to rent." Business will be off due to higher inventory costs, and less flight training at Boeing Field. Likely there will be a decrease in size due to budget cuts. Sales will probably go down due to the general economic downturn.

V. Comparisons with the 1998 and 2002 KCIA Economic Impact Studies

This study has been conducted through the utilization of a methodology almost identical to that used in the 1998 and 2002 KCIA Economic Impact Studies[6]. We purposefully tried to use measurement procedures so that we could compare results obtained in the current study with the ones benchmarked against the year 1998 and 2002. Although this was our approach, there are some differences in procedure that have influenced impact analysis outcomes and direct impact measurements.

Key inputs common to both studies are:

(1) This study and the 1998 and 2002 studies are essentially benchmarked against what tenants have reported to us. Employment, labor income, and sales of tenants and subtenants at the airport, were used as reported by them to the study team. We have assumed that they have provided us with accurate estimates of their business activity.

(2) A model of the regional economy with similar multiplier structures, based on the Washington State input-output model. There are differences in the multiplier structure in the current study and in the model used in the 1998 and 2002 studies. In 2008 a new input-output model for the Washington economy was published, benchmarked against the year 2002[7]. The 1998 study utilized the 1987 Washington input-output study, while the 2002 study used the 1997 Washington input-output study as the basis for the King County models developed for the purpose of those studies.[8]

Figures 4, and 5 portray the relative importance of broad industry groups for the year 1998, 2002 and 2008. Employment was estimated to have declined from 4,078 in 1998 to 3,934 in 2002, but is estimated to have increased to 4,866 in 2008. Figure 4 indicates that the greatest volatility in employment has been in the aerospace sector. FBO/Corporate Air employment has been relatively stable, while air cargo/airline and government employment show decline across the three studies[9]. The increase in "other" employment is related to changes in estimates of employment at the Museum of Flight, airline representatives located at KCIA and considered as part of the services sector, and other tenants.

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[6] William B. Beyers & Shaun McMullin. King County International Airport Economic Impact Study. February 2000. William B. Beyers & Stephen J. Hyde. (2002) Economic Impact of the King County International Airport. Prepared for King County.

[7] William B. Beyers & Ta-Win Lin. The 2002 Washington State Input-Output Model. http://www.ofm.wa.gov/economy/io/2002/default.asp

[8] Robert A. Chase, Philip J. Bourque, and Richard S. Conway Jr.. Washington State Input-Output 1987 Study. Olympia WA: Office of Financial Management. Richard S. Conway Jr., The 1997 Washington Input-Output Model. http://www.ofm.wa.gov/economy/io/1997/default.asp

[9] Much air cargo employment is part-time. Table 1 shows a headcount of 537 persons, similar to the level in the 1998 and 2002 studies, while Figure 4 is reporting estimated full-time equivalent employment in 2008.

Figure 4 Employment at KCIA in 1998, 2002, and 2008

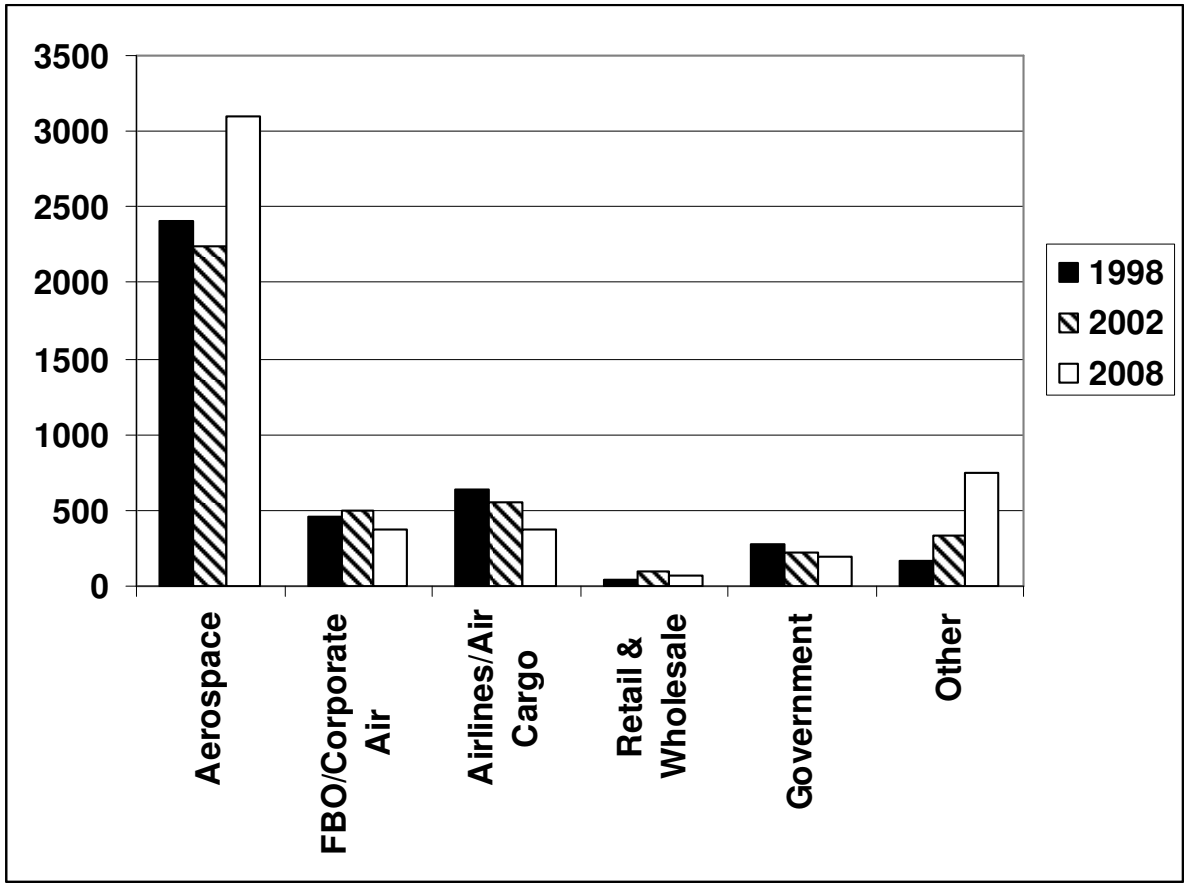
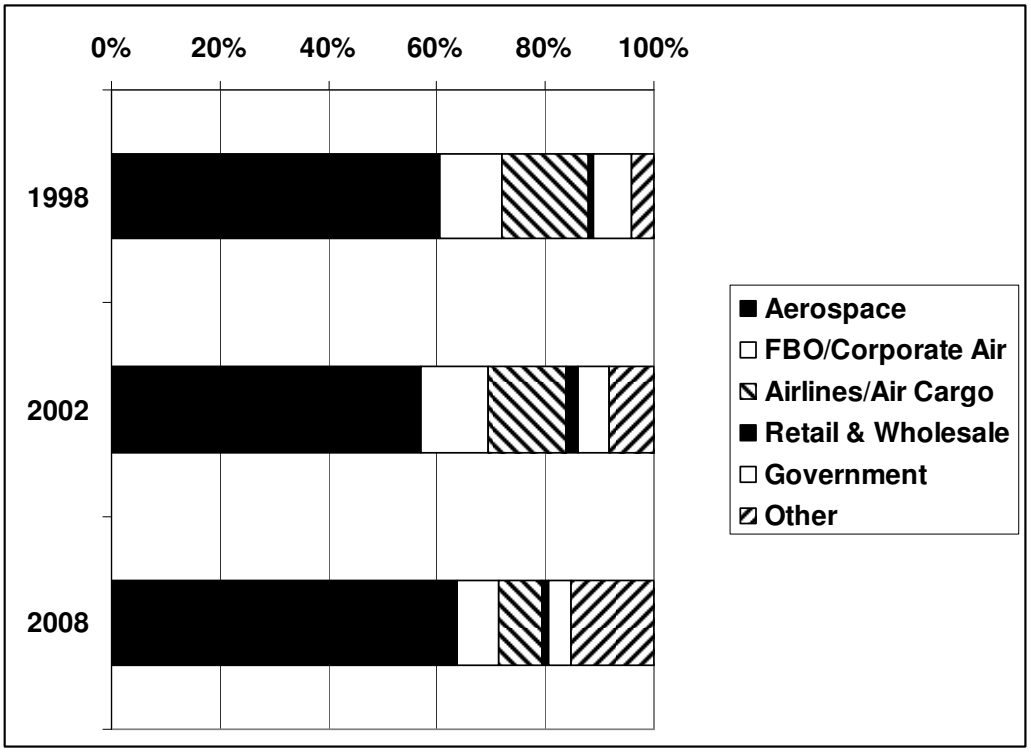


Figure 5 reports the composition of employment at KCIA in 1998, 2002, and 2008. The data used for this figure are the same as used for Figure 4. In all three studies, the aerospace sector has accounted for around 60% of total employment at KCIA. This figure would increase to near 70% if airline delivery representatives were included in this total. The absolute increase in estimated aerospace employment in the 2008 study leads to a corresponding decrease in share of total employment accounted for by other categories of employment at KCIA. The absolute decline of employment in airlines/air cargo and government reported in Figure 4 also are evident in Figure 5.

Figure 5 Composition of Employment at KCIA



Multipliers used in the three studies are similar. Table 14 presents these multiplier estimates. The modest difference in multipliers in the 1998 and 2002 studies is likely accounted for by small variations in the input-output direct, indirect, and induced requirements matrices used in the two studies and is related to changes in the mix of industries located at KCIA. The current study used the new 2002 Washington State input-output model, and multipliers from this model are lower for output and labor income, while the employment multiplier for KCIA appears to be identical to those derived in the 1998 and 2002 studies.

Table 14 Multiplier Comparison

	1998 study	2002 study	Current Study
Output Multiplier	1.47	1.59	1.43
Employment Multiplier	2.59	2.59	2.59
Labor Income Multiplier	1.94	1.93	1.69

Direct measures of sales are higher in the current study than in the 1998 and 2002 studies. Differences in prices and productivity are likely contributors to these differences. Table 15 reports sales for the three studies. It should be noted that this table has a slightly different scheme for grouping businesses than used in the 1998 study, and the authors have adjusted data in the 1998 database to make them comparable to the industry definitions used in the current study. The 1998 study counted a number of the reservists at the National Guard station as employees in the government sector, while in this study we did not count any activity at the National Guard site.

Table 15 Sales Comparison

	1998 Sales $ millions	2002 Sales $ millions	Current Study $ millions
Aerospace	$778.29	$680.748	$1,971.97
FBO & Corporate Air	67.34	101.645	115.11
Air Passenger & Air Cargo	81.03	68.025	115.26
Wholesale and Retail	2.79	40.925	5.8
Government	26.52	41.212	18.597
Other	20.06	67.959	30.121
Total	$976.03	$1,039.214	$2,256.858

Labor income per employee is reported in Table 16 for the three studies. No attempt has been made to standardize these estimates due to inflation. In all three studies the earnings of aerospace workers were high. The 2002 study shows earnings for the government sector well above the level found in the current study and in the 1998 study. The input-output model does not have a government sector. To estimate impacts associated with government employment, the 2002 study treated government as if it were a part of the "other services" sector, leading to a relatively high estimated earnings level. In the current study, government has been treated as if it were a part of sector 41, legal/accounting and bookkeeping/management services.

Table 16 Labor Income Comparisons

	1998 Labor Income Per Job	2002 Labor Income Per Job	Current Study
Aerospace	$52,623	$77,899	$112,143
FBO & Corporate Air	$44,044	$50,445	67,430
Air Passenger & Air Cargo	$30,381	$37,949	47,212
Wholesale and Retail	$26,944	$39,560	31,500
Government	$44,007	$94,053	60,045
Other	$45,244	$47,675	39,106
Total	x	x	$97,574

Table 17 presents a comparison of estimates of the share of new money from the three studies. As with the other comparisons in this section, this table is not directly comparable to the percentages of new money shown in the 1998 study, due to slight differences in industry groupings. The overall orientation of businesses at KCIA remains strongly tied to export markets, with a similar aggregate percentage of new money in the two studies. The "other" sector shows a strong increase in export orientation in the 2002 study, as airline representatives were included in this category in the 2002 study, and they are included with aerospace in the current study.

Table 17 New Money Comparison

	1998 Study	2002 Study	Current Study
Aerospace	99.3%	99.8%	100.0%
FBO & Corporate Air	27.6%	22.7%	59.4%
Air Passenger & Air Cargo	52.4%	57.7%	60.6%
Wholesale and Retail	45.8%	34.3%	29.7%
Government	29.5%	36.4%	12.8%
Other	31.7%	79.7%	23.4%
Total	87.0%	81.5%	94.0%

A final perspective on the three KCIA economic impact studies comes from a comparison of their economic impact estimates. Figures 6 and 7 present these estimates, with Figure 6 showing the total employment levels, and Figure 7 shows the mix of employment by broad category. It should be noted that the first two studies were conducted using the Standard Industrial Classification (SIC), while this study utilized the North American Industry Classification System (NAICS). Differences in definitions between these two systems create minor issues related to the aggregation of detailed industry codes as reported in Figures 6 and 7. Each of these studies measured impacts in terms of output (sales), employment, and labor income. We are just reporting employment impacts here; interested readers can develop comparative measures on other dimensions by accessing each of these studies.

Figure 6 Total Employment Impacts

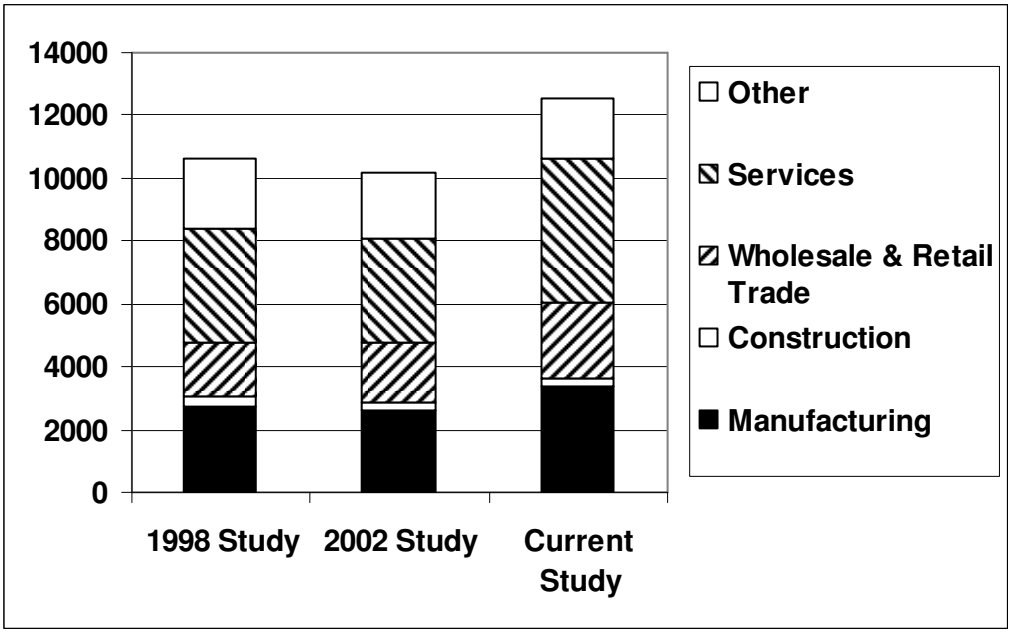
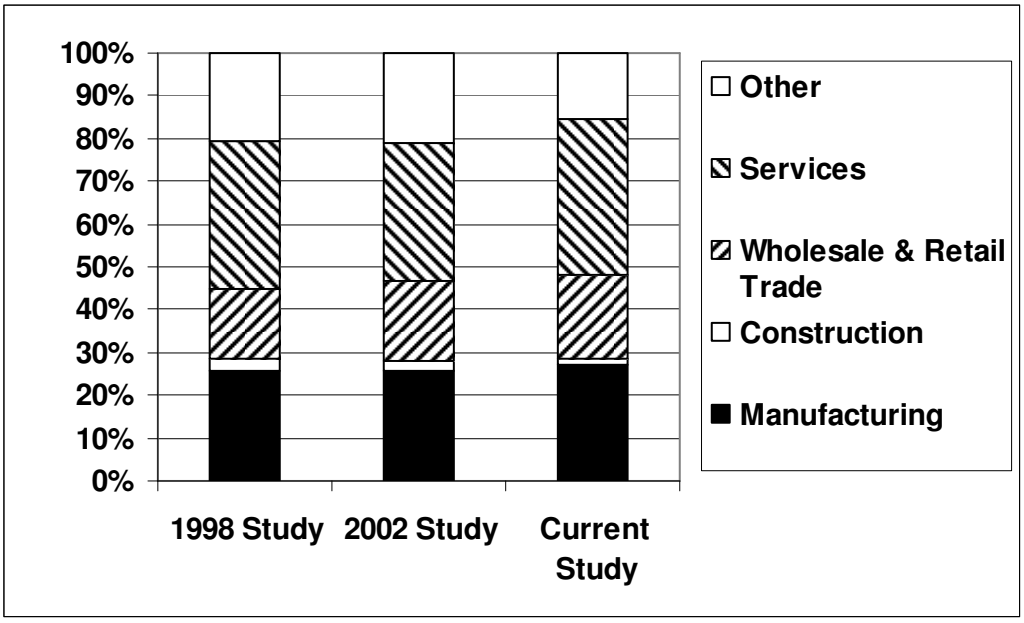


Figure 6 and 7 clearly show that most impacts are felt in the wholesale and retail trade, as well services sectors. Services are defined as business, health, and consumer services. "Other" includes transportation, communications, utilities, and financial services, as well as natural resources. Total job impacts mirror direct job levels, reported

in Figure 4. The current study indicates about 2,000 more jobs supported in King County when compared to the 1998 and 2002 studies. Figure 7 reports very similar shares of total employment impact across the three studies, a result driven by the relative stability of the mix of direct economic impacts. Differences in these estimates are also related to the different input-output models used for these studies; each study has used a different Washington State model to derive a King County model.

Figure 7 Share of Total Employment Impacts



VI. Concluding Comments

This study has documented the economic impact of KCIA on the King county economy for the year 2008. It was based on a survey of the principal tenants at KCIA and on information that they provided us with regarding their subtenants. We believe that tenants in this study have provided us with reasonably accurate information, and that the impact estimates developed in this study are a good approximation of the economic impact of KCIA for the year 2008. KCIA generated more than 12,600 jobs in King County in 2008, was responsible for sales by King County businesses of $3.2 billion, and supported the earnings of $0.8 billion in labor income. About $68 million in state and local sales and B&O taxes were generated as a result of economic activity at the airport. Directly, 4,900 people worked at the airport in 2008, earning $475 million in labor income.

The project has clearly measured the diverse economic activity that takes place at KCIA, a busy general aviation airport in the middle of one of the nation's largest metropolitan areas. The airport makes a significant contribution to the economic base of King County. The nature of this contribution has changed somewhat since the conduct of the economic impact studies benchmarked against the years 1998 and 2002. The Boeing

Company was operating at a higher level at KCIA than was the case in the 1998 and 2002 studies. This level of activity is not likely to be sustained in the near future, as the company has announced layoffs related to the current recession. Retail/wholesale and government activity at KCIA has declined, while air cargo and FBO/Corporate air activity appears to have been stable. While many tenants are experiencing a downturn in business due to the current recession, many of them are optimistic about the development of their business in the long-run.

It is inevitable that there is dynamism in the mix of tenants and their level of business activity at an airport like KCIA. Shifts in earnings levels, effects of inflation and productivity change, and other dynamic factors, date studies such as this and lead to a need for their update every few years.

Appendix A King County International Airport Economic Impact Study 2008

Responses to this survey will be treated as confidential. Responses from individual businesses will be combined with information from other respondents to preserve confidentiality. No survey data will be given to King County.

Establishment Name _____

Interviewer _____ Date of Interview _____

Person Interviewed _____

1. Description of products or services: _____

_____

2. Sales or Budget (most recent fiscal year) $_____

3. Market Composition (% of sales or budget):

	% of Total	% from King County sources	Expected % Five years from now	Expected % from King County Sources Five Years from Now
Industry Markets	%	%		
Household Markets	%	%		
Governments – Local or State	%	%		
Government – Federal	%	%		
Total	100.0%		100.0%	

Market Trends – How do you see your lines of business changing over the next 2 to 5 years?

Line of Business	% Increase	% Decrease	Comment
Corporate			
General Aviation			
Cargo			
Flight School			
Other --			

4. How many employees on average do you have that are: _____ Full time _____ Part time

5. What was your total level of employee compensation in your most recent fiscal year?
(E.g. wages & salaries as well as fringe benefits)
$_____

6. How has your sales (budget) changed the downturn in the national economy since 2006?
☐ No Change ☐ Has Decreased ☐ Has Increased

a. If their sales (budget) has changed, by what % _____
b. Why has this change occurred?

_____

7. How do you anticipate you sales (budget) will change over the next 2 years (to 2010)?
☐ No Change ☐ Will Decrease ☐ Will Increase

a. If they think their sales will change, by what % _____
b. Why do you expect this change?

_____
_____

8. *(Ask this only to those with no recorded subtenants).* Do you have tenants or subtenants? If yes, who are they, how many people do they employ, what is their business, and how much of it is sold in King County?

_____

Appendix B. List of Tenants Included in this study

	NAICS Code
Carey, Christopher	230000
Talon Construction	236118
Boeing Company & Jet Engine Manufacturers	336411
Aviation Partners, Inc.	336413
Western Metal Products, Inc	336413
Aircraft Interior Solutions	441229
Mente Aviation	441229
Rainer Aviation	441229
Sentient Flight Group	441229
Tag Aviation	441229
National Aviation, Inc	441229
Hawker Beechcraft	441229
American Avionics	443112
Rosso Nursery	444220
Aviator Book Company / Aviators Store	451211
Kenmore Air Harbor	481110
Seaport Air Group	481111
Airborne Express/DHL	481112
BAX Global	481112
Airpac Airlines	481112
Airlift Northwest	481200
Air Methods	481200
Skway Courier	484110
Skagit Transportation (Formerly Great Western Soil Conditioners)	484110
Erin Air	487210
Aviation Methods	488119
Classic Helicopter	488119
Hangar Holdings, Inc.	488119
King County Jet Center	488119
Nordstrom	488119
Wings Aloft	488119
Galvin Flying Service	488119
Clay Lacy Flight Center	488119

Aircraft Magneto Services	488190
Ashton Corporation	488190
Reed Aviation	488190
South End Aviation	488190
Integrated Air Line Services	488190
Aeroflight	488190
Ameriflight	492110
Mountain High Aviation	492110
United Parcel Service	492110
Concept Systems	510000
Jet Direct	532411
Valkryie Leasing Corporatin	532411
Boeing airplane Purchasers	540000
Paladin Aerospace	541511
Pro-Micro	541511
Opportunity Skyway	611100
So. Seattle Community College	611100
Aviation Training Center	611211
The Flight Academy	611512
Helicopters Northwest	611512
Washington Audiology	621340
Museum of Flight	712110
Cavu Cafe	722213
Duncan Aviation	811213
Airtech Instruments	811219
Airwest (Bicknell)	8112
FAA - AFSS	921190
King County Safety & Claims Management	923100
King County E-911	923100
King County Sheriff Special Operations	923100
King County Wastewater Treatment Division	923100
King County Airport Administration Office	923100
King County Airport Maintenance	923100
U.S. Dept. Of Customs	923100
Washington National Guard	923100

Appendix C. Technical Appendix on the Input-Output Model

The impact estimates developed in this study stem from the utilization of an "input-output model." Models of this type are based on static, cross-sectional measures of trade relationships in regional or national economies. They document how industries procure their inputs and where they sell their outputs. Pioneered by Wassily Leontief, who won the Nobel Prize in Economic Science for his insights into the development of input-output models at the national level, these models have become "workhorses" in regional economic impact analysis in recent decades.

Washington State is fortunate to have a rich legacy of research developing input-output models. Early work was led by Philip J. Bourque and Charles M. Tiebout. Input-output models have now been estimated in Washington State for the years 1963, 1967, 1972, 1982, 1987, 1997 and 2002. No other state in the U.S. has this rich historical legacy of survey-based or quasi-survey based regional input-output models. The current is based on work completed in 2007-2008 by a team of Washington State government staff and William B. Beyers (Beyers and Lin 2008).

Input-output models decompose regional economies into "sectors"–groups of industries with a common industrial structure. The heart of these models is "Leontief production functions," which are distributions of the cost of producing the output of sectors. Leontief augmented the national accounts schema developed by Kuznets (also a Nobel laureate in economics) to take into account the significant levels of intermediate transactions that occur in economic systems in the process of transforming raw materials and services into "finished products" or "final products." Sales distributions among intermediate and final sources of demand are used as the accounting bases for the development of the core innovation of Leontief: that these relationships can be used to link levels of final demand to total industrial output by way of a system of "multipliers" that are linked through the channels of purchase in every industry to the production of output for final demand.

This system of relationships is based on accounting identities for sales. Mathematically, the system may be represented as follows. For each industry we have two balance equations:

(1) $X_i = x_{i,1} + x_{i,2} + ... + x_{i,n} + Y_i$

(2) $X_j = x_{1,j} + x_{2,j} + ...+ x_{n,j} + V_j + M_j$

where: X_i =total sales in industry i,
X_j = total purchases in industry j
$x_{i,j}$ = intermediate sales from industry i to industry j
Y_i = final sales in industry i
M_j = imports to sector j
V_j = value added in sector j.

For any given sector, there is equality in total sales and total purchases:

(3) $X_i = X_j$ when i=j.

This system of transactions is generalized through the articulation of Leontief production functions, which are constructed around the columns of the regional input-output model. They are defined in the following manner.

Let us define a regional purchase coefficient:

$$r_{i,j} = x_{i,j}/X_j.$$

Rearranging,

$$x_{i,j} = r_{i,j}X_j$$

Substituting this relationship into equation (1) we have:

(4) $$X_i = r_{i,1}X_1 + r_{i,2}X_2 + ... + r_{i,n}X_n + Y_i$$

Each sector in the regional model has this equation structure, and since the values of X_i equal X_j when i=j, it is possible to set this system of equations into matrix notation as:

(5) $$X = RX + Y$$

This system of equations can then be manipulated to derive a relationship between final demand (Y) and total output (X). The resulting formulation is:

(6) $$X = (I-R)^{-1}Y$$

where the $(I-R)^{-1}$ matrix captures the direct and indirect impacts of linkages in the input-output model system. The input-output model utilized in the modeling for this research project was based on the Washington State model published in 2008 by the Washington State Office of Financial Management. The model has 50 sectors. This model was adjusted for use in this study, by the development of a King County matrix of direct requirements coefficients (the R matrix). Location quotients were used to adjust the state direct requirements coefficients; in sectors where King County has a location quotient less than 1.0, the location quotient was multiplied against the row of state coefficients to obtain lowered estimates of King County direct requirements (See Table Appendix C-1). Sectors with location quotients of 1.0 or more did not require adjustment of the state coefficients.

A major issue that surrounds the estimation of the $(I-R)^{-1}$ matrix is the level of "closure" with regard to regional final demand components, which are personal consumption expenditures, state and local government outlays, and capital investment. It is common practice to include the impacts of labor income and the disposition of this

income in the form of personal consumption expenditures in the multiplier structure of regional input-output models. The additional leveraging impact of these outlays is referred to as "induced" effects in the literature on models of this type. It is less common to include state and local government expenditures in the induced effects impacts, but it can be argued that demands on state and local governments are proportional to the general level of business activity and related demographics. In contrast, investment is classically argued to be responsive to more exogenous forces, and is not a simple function of local business volume. In the model that we developed for this impact study we have included personal consumption expenditures as a part of the induced-demand linkages system, as well as state local government expenditures as a function of other value added except labor income. We have considered Washington personal consumption expenditures to be a function of labor income.

Space does not permit reproduction of the $(I-R)^{-1}$ inverse matrix with this report. Interested parties can contact William Beyers at beyers@u.washington.edu to obtain a copy.

Table C-1 Location Quotients Used to Modify Direct Requirements

1. Crop Production	0.0445
2. Animal Production	0.0445
3. Forestry and Logging	0.1961
4. Fishing, Hunting, and Trapping	1.0000
5. Mining	0.3512
6. Electric Utilities	0.9057
7. Gas Utilities	0.9057
8. Other Utilities	0.9057
9. Construction	0.8339
10. Food, Beverage and Tobacco Manufacturing	0.9188
11. Textiles and Apparel Mills	1.0000
12. Wood Product Manufacturing	0.2661
13. Paper Manufacturing	0.4951
14. Printing and Related Activities	1.0000
15. Petroleum and Coal Products Manufacturing	0.1058
16. Chemical Manufacturing	1.0000
17. Nonmetallic Mineral Products Manufacturing	0.7890
18. Primary Metal Manufacturing	0.3970
19. Fabricated Metals Manufacturing	0.7992
20. Machinery Manufacturing	0.9725
21. Computer and Electronic Product Manufacturing	0.8593
22. Electrical Equipment Manufacturing	0.9781
23. Aircraft and Parts Manufacturing	0.9732
24. Ship and Boat Building	0.6268
25. Other Transportation Equipment Manufacturing	1.0000
26. Furniture Product Manufacturing	0.6739
27. Other Manufacturing	0.9801
28. Wholesale	1.0000

Table C-1 Continued

29. Retail	0.8655
30. Air Transportation	1.0000
31. Water Transportation	1.0000
32. Truck Transportation	0.7789
33. Other Transportation/Postal Offices	0.9741
34. Support Activities for Storage, Transportation and Warehousing	1.0000
35. Software Publishers & Internet Service Providers	1.0000
36. Telecommunications	1.0000
37. Other Information	1.0000
38. Credit Intermediation and Related Activities	1.0000
39. Other Finance and Insurance	1.0000
40. Real Estate and Rental and Leasing	1.0000
41. Legal /Accounting and Bookkeeping /Management Services	1.0000
42. Architectural, Engineering, and Computing Services	1.0000
43. Educational Services	0.9800
44. Ambulatory Health Care Services	0.7743
45. Hospitals	0.8906
46. Nursing and Residential Care Facilities, Social Assistance	0.7749
47. Arts, Recreation, and Accommodation	1.0000
48. Food Services and Drinking Places	0.9138
49. Administrative/Employment Support Services	1.0000
50. Waste Management/Other, and Agriculture Services	0.7688
Labor Income	1.0000
Other Value Added	1.0000

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